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Document Number 3

Entry 3 of 3

File: DWPI

Oct 4, 1989

DERWENT-ACC-NO: 1989-287584

DERWENT-WEEK: 198940

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TITLE: Prepn. of upgraded coconut - by treating aq. suspension of meat particles with cell wall degrading enzyme and galacto-mannase and sepg. sludge

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PRIORITY-DATA:

1988DK-0000777

February 16, 1988

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
GB 2215980 A	October 4, 1989	N/A	022	N/A
DK 8800777 A	August 17, 1989	N/A	000	N/A
GB 2215980 B	November 27, 1991	N/A	000	N/A
US 4904483 A	February 27, 1990	N/A	000	N/A

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-NO
GB 2215980A	February 15, 1989	1989GB-0903432	N/A
US 4904483A	February 15, 1989	1989US-0310621	N/A

INT-CL (IPC): A23L 1/21; A23L 2/38; C11B 1/00

ABSTRACTED-PUB-NO: GB 2215980A

BASIC-ABSTRACT:

An upgraded coconut (I) prod. is prepd. as follows: (a) an aq. suspension of particles of opt. purified (I) meat is treated with a cell wall - degrading enzyme (II) and a galactomannase (III) (all free of lipases); and (b) a sludge phase is sepd. and removed.

Pref. ratio dry (I) : H₂O = 0.1-0.25:1. Prefd. (I) has 90% of the particles smaller than 1 mm. Treatment is pref. for 1-6 hr. Opt. the aq. (I) suspension is heat treated before the enzymic treatment. Prefd. (II) is an SPS-ase prepn. (of activity esp. 10-700 SPS-ase units/kg dry (I)) used with (III) (of activity esp. 1.5 x 10 power(6) - 200 x 10 power(6) galactomannase units/kg dry (I)). The (III) portion of the enzyme mixt. pref. also contains another hemicellulase. Sludge removal is pref. by centrifugation; coconut oil removal may be by decantation or centrifugation.

ADVANTAGE - Treatment of coconut particles with the lipase-free enzyme mixt. above gives higher yields of directly recoverable clear coconut oil. In

addn., the sepd. sludge phase may be used as fodder.
ABSTRACTED-PUB-NO:

GB 2215980B
EQUIVALENT-ABSTRACTS:

A method for production of an upgraded coconut product, which comprises the steps of: enzymatically treating an aqueous suspension of particles of coconut meat, which may be purified, with a cell wall degrading enzyme and a galactomannase, all essentially free from lipases, and separating a sludge phase.

US 4904483A

Upgraded coconut prod. is formed by (a) enzymatically treating an aq. suspension of particles of coconut meat with a cell wall degrading enzyme and a galactomannase, but no lipase; and (b) sepg. sludge phase.

90% of coconut meat particles are less than 1mm, Opt. aq. suspension is heat treated before enzymatic treatment. Cell wall-degrading enzyme is an SPS-ase prepn. Opt. a hemicellulase is present.

ADVANTAGE - Clear oil phase contg. most of the oil is generated after enzymatic treatment is completed. (10pp)

CHOSEN-DRAWING: Dwg.0/4

TITLE-TERMS:
PREPARATION UPGRADING COCONUT TREAT AQUEOUS SUSPENSION MEAT PARTICLE CELL
WALL DEGRADE ENZYME GALACTO MANNASE SEPARATE SLUDGE

DERWENT-CLASS: D13 D16

CPI-CODES: D03-C; D03-G04;

SECONDARY-ACC-NO:
CPI Secondary Accession Numbers: C1989-127223

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(12) **UK Patent Application** (19) **GB** (11) **2 215 980** (13) **A**
(43) Date of A publication 04.10.1989

(21) Application No 8903432.6

(22) Date of filing 15.02.1989

(30) Priority data

(31) 077788

(32) 16.02.1988

(33) DK

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(51) INT CL⁴

A23L 1/212 2/38, C11B 1/00

(52) UK CL (Edition J)

A2B BLX B333 B341 B822

A2Q Q13 Q14X Q16B2 Q16D Q16X Q7B

C5C CAA C104 C202

(56) Documents cited

None

(58) Field of search

UK CL (Edition J) A2B BLF BLX BMH12 BMH19

BMH29 BMH39 BMV5 BW, A2Q, C5C CAA

INT CL⁴ A23L

(54) **Method for production of an upgraded coconut product**

(57) A method for production of an upgraded coconut product comprises the steps of: enzymatically treating an aqueous suspension of particles of coconut meat with a cell wall degrading enzyme and a galactomannase, all essentially free from lipases, and separating a sludge phase. By means of this method a higher yield of directly recoverable clear coconut oil can be obtained in comparison to the yield of directly recoverable clear coconut oil produced by known methods for aqueous coconut oil extraction.

The term "coconut meat" includes all kinds of raw or purified coconut meat, e.g. copra, desiccated coconut.

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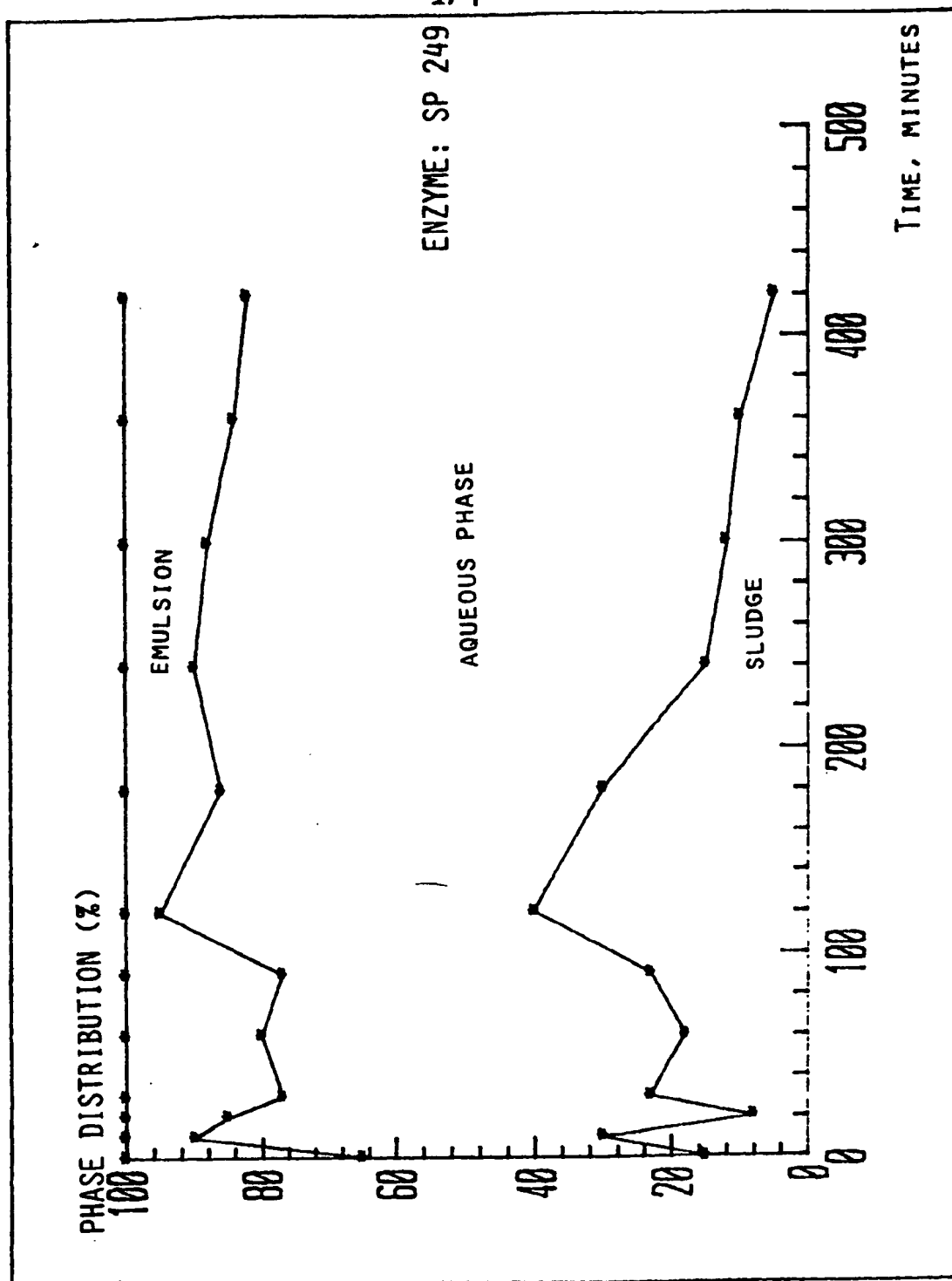


FIG. 1

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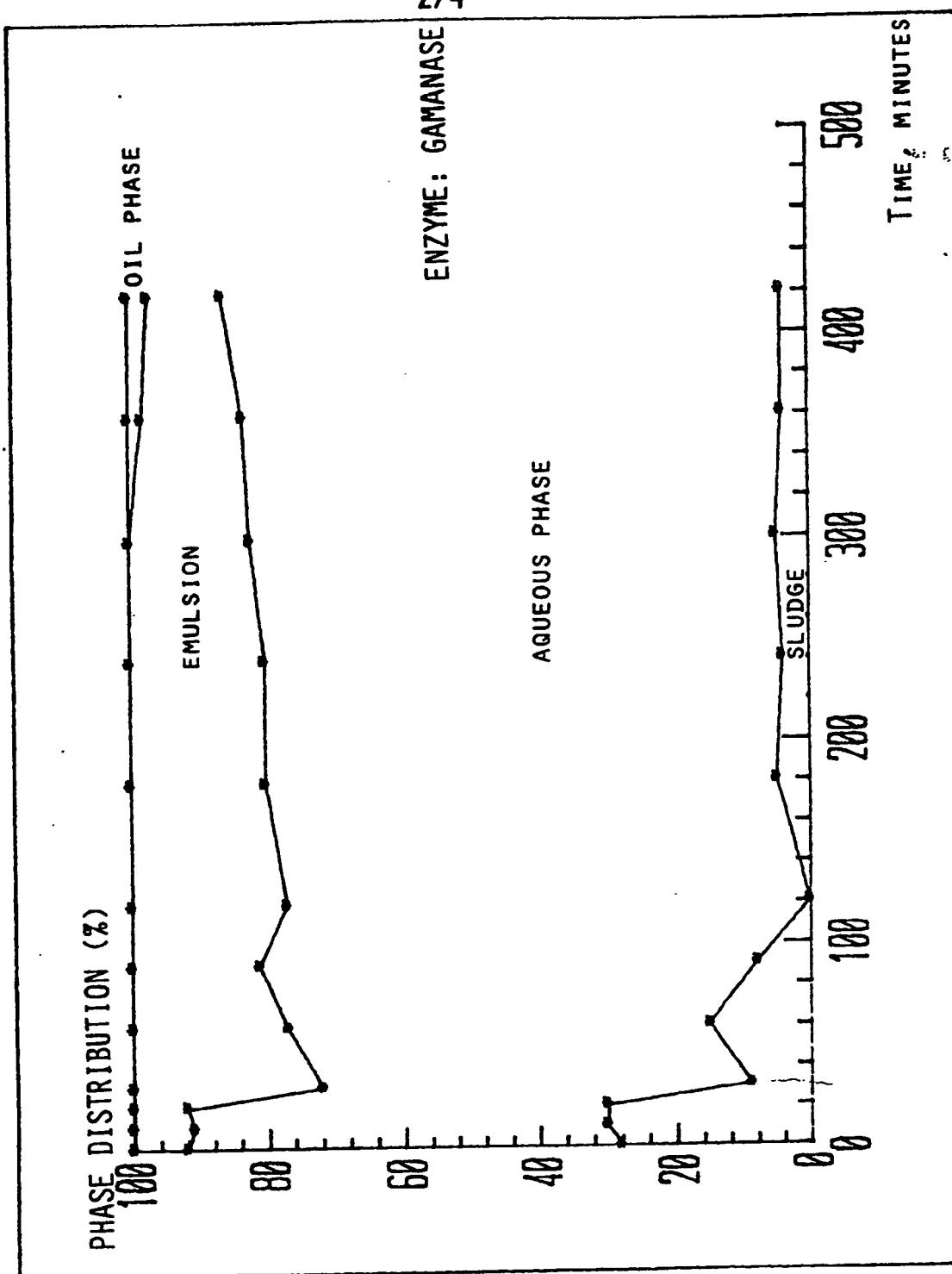


FIG. 2

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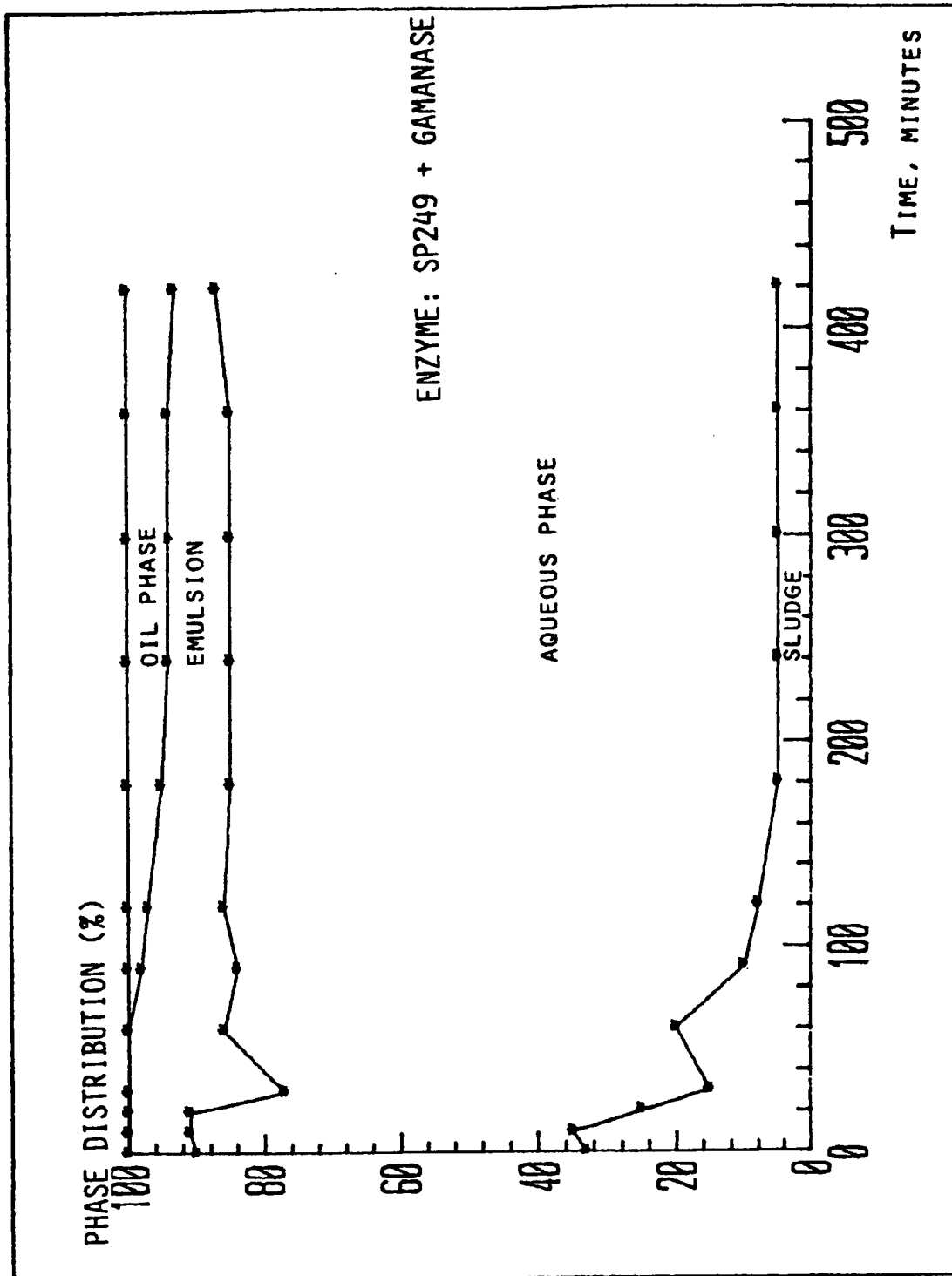


FIG. 3

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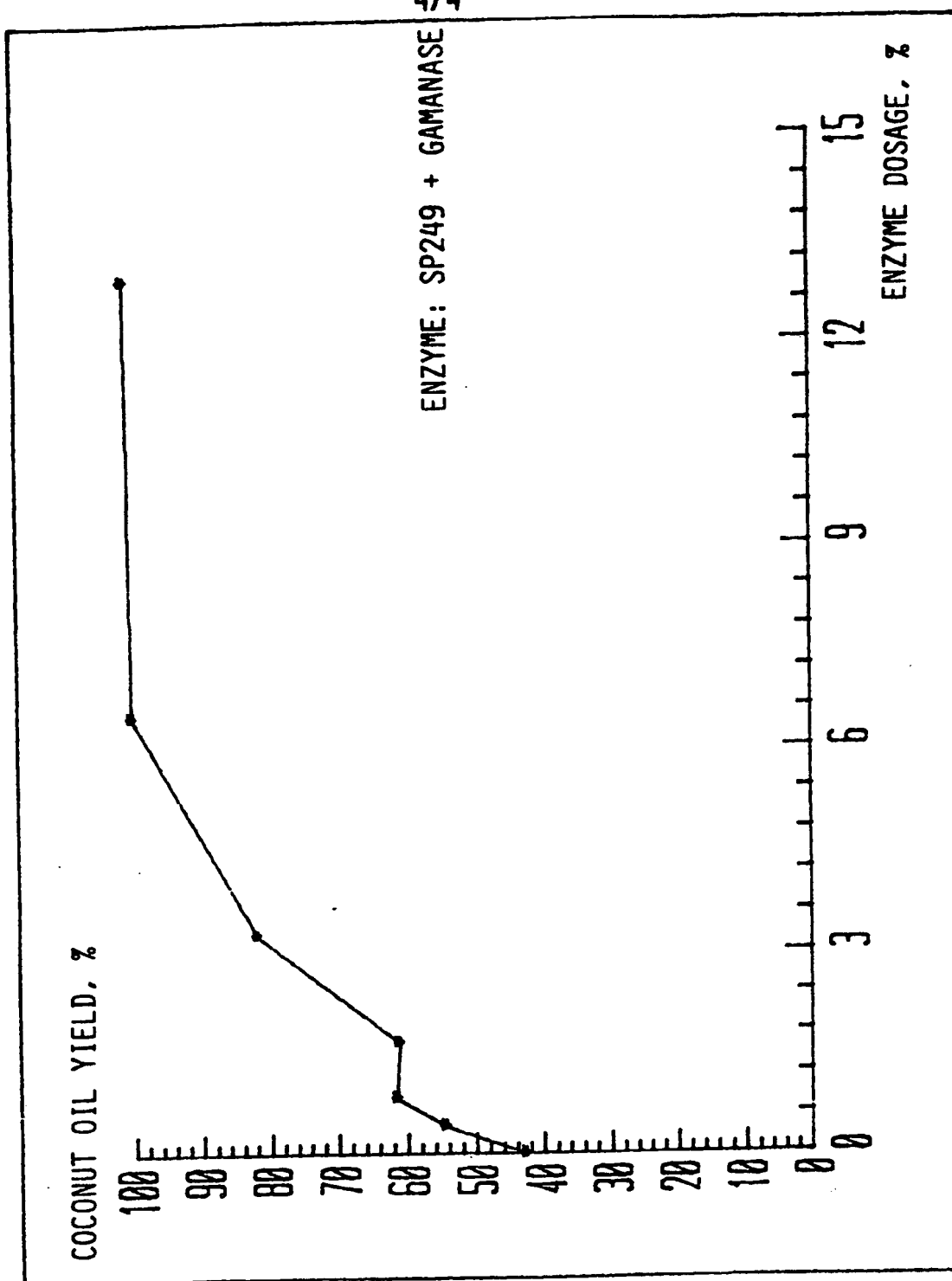


FIG. 4

"Method for production of an upgraded coconut product"

The invention comprises a method for production of
5 an upgraded coconut product, mainly coconut oil and coconut
milk.

From GB patent No. 2 115 820, page 37 it appears
that aqueous extraction of corn germ oil, olive oil, soy oil,
rape seed oil and sunflower oil can be improved by means of
10 an SPS-ase preparation which is essentially free from
lipases.

If an attempt to produce coconut oil in the same
manner, i.e. by aqueous extraction with an SPS-ase
preparation, is carried out, very poor results in terms of
15 directly recoverable clear coconut oil are obtained; the
majority of the oil or the entire amount of the oil is
present as an emulsion, from which it is difficult to recover
the coconut oil. Thus, aqueous extraction of coconut oil
seems to present special problems in comparison to other
20 types of vegetable oil.

Thus, a need exists for a method for production of
an upgraded coconut product including coconut oil by aqueous
extraction, whereby a higher yield of directly recoverable
clear coconut oil can be obtained in comparison to the yield
25 of directly recoverable clear coconut oil produced by known
methods for aqueous coconut oil extraction.

SUMMARY OF THE INVENTION

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According to the invention it has been found that
the above indicated need can be fulfilled, if a mixture of a
cell wall degrading enzyme and a galactomannase, all
essentially free from lipases, is used for the aqueous
35 extraction.

Thus, the method according to the invention for production of an upgraded coconut product comprises the steps of enzymatically treating an aqueous suspension of particles of coconut meat, which may be purified, with a cell wall
5 degrading enzyme and a galactomannase, all essentially free from lipases and separating a sludge phase.

As the enzyme treated aqueous suspension of particles of coconut meat can be separated into an aqueous phase, an oil phase, and a sludge phase, the upgraded coconut
10 products produced according to the invention can be any of these three phases or a combination thereof, mainly coconut oil, coconut milk (the emulsified combined water and oil phase), and the sludge phase, which can be used as fodder. As appears later from this specification, in certain cases also
15 a minor proportion of an emulsion phase can be present as a fourth separation phase.

In German published patent specification No. 21 04 259 a method for recovery of oil from cereal germs is described, whereby the cereal germs are dried in a
20 specific manner, slurried in an aqueous medium and treated with cellulase. However, in contradistinction to the prior art method the method according to the invention is specifically directed to coconut meal as a starting material and to a specific combination of two well defined enzyme
25 activities not disclosed in the German publication, and also, drying of the starting material is no critical aspect in relation to the method according to the invention.

In this specification with claims it is to be understood that the term "coconut meat, which may be
30 purified", comprises all kinds of raw or purified coconut meat, e.g. copra or desiccated coconut.

In this specification with claims it is to be understood that the term "cell wall degrading enzyme" comprises a pectinase, an SPS-ase, a cellulase, and/or a

protease. Thus, the term "a cell wall degrading enzyme" comprises one or more of the above enzymes, purified or in the form of crude preparations.

Examples of cell wall degrading enzymes appear from the following table.

Enzyme	Preparation	Activity unit	Definition of activity unit
10 Pectinase	Pectinex 3xL	3000 FDU/g	B-235d-GB
SPS-ase	SP-249 (PPS 1927)	28 SPSU/g	B-297f-GB
Cellulase	CELLUCLAST® 1.5L	1500 NCU/g	B-153g-GB
15 Protease	ALCALASE® 2.4L	2.4 AU/g	B-318a-GB

In this specification with claims, a galactomannase is a hemicellulase with a specific activity towards galactomannan. A galactomannase preparation is marketed by NOVO Industri A/S , Novo Allé, 2880 Bagsvaerd, Denmark under the trade mark Gamanase®. Reference can be made to the pamphlet B-046d-GB, available on request from NOVO Industri A/S, like the above pamphlets indicated in the last column of the table. The definition of the activity unit for the galactomannase appears from the pamphlet B-046d-GB.

The term "essentially free of lipase" means that the content of lipase in the enzyme preparation does not result in an increased release of free fatty acids from the oil during processing as compared to conventional processing.

It has been surprisingly found that the reaction mixture after the enzymatic treatment can be separated into a sludge phase, an aqueous phase, an emulsion phase and a large clear oil phase. If one or more cell wall degrading enzymes

are used without the galactomannase, or if the galactomannase is used without cell wall degrading enzymes, no clear oil phase or an extremely small clear oil phase is formed.

In a preferred embodiment of the method according to the invention, 90% of the particles of the coconut meat is smaller than 1 mm. In this manner a higher yield of clear coconut oil is obtained.

In a preferred embodiment of the method according to the invention the aqueous suspension of particles of coconut meat is heat treated, preferably by jet cooking or UHT (ultra high temperature) treatment before the enzymatic treatment. In this manner the liberation of oil from the cells in the coconut meat is facilitated, and the effect of the later performed enzyme treatment is enhanced.

In a preferred embodiment of the method according to the invention the enzymatic treatment is carried out with a mixture of an SPS-ase preparation and a galactomannase. In this manner the largest possible yield of clear coconut oil is obtained. Another reason why this embodiment is advantageous is the fact that both the SPS-ase preparation indicated in the above table and the GAMANASE® galactomannase preparation are practically free of lipases, and thus, lipase removal treatments are superfluous, and the quality of the coconut oil is not impaired during extraction.

In a preferred embodiment of the method according to the invention the galactomannase part of the enzyme treating agent comprises another hemicellulase besides the galactomannase. In this manner a larger yield of clear coconut oil is obtained.

In a preferred embodiment of the method according to the invention between 10 and 700 SPS-ase activity units and between 1.5×10^6 and 200×10^6 galactomannase activity units are used per kg of dry matter of coconut meat, and the enzymatic treatment is carried out between 1 and 6 hours. In

this manner the optimum compromise between enzyme activities and treatment times can easily be selected in order to obtain maximum yield of clear coconut oil.

In a preferred embodiment of the method according to the invention the ratio between dry coconut meat and water in the aqueous suspension is between 0.10 and 0.25. In this manner the process is carried out with a relatively small water volume and yet efficiently.

In a preferred embodiment of the method according to the invention the separation of the coconut oil is carried out by centrifugation. In this manner the separation is carried out rapidly and efficiently.

In a preferred embodiment of the method according to the invention the separation of the coconut oil is carried out by decantation. In this manner the separation can be carried out by means of a cheap sedimentation apparatus, which typically can be used with advantage instead of a centrifuge.

20

BRIEF DESCRIPTION OF THE DRAWINGS

Also, reference is made to the accompanying Figures 1, 2, and 3, which will be explained in more detail later in this specification.

Figs. 1 and 2 are graphs which show the relative amounts of the various phases after treatment of coconut meat with SPS-ase (Fig. 1) and GAMANASE® galactomannase (Fig. 2). Fig. 1 and Fig. 2 are considered representative of an unsatisfactory technique in terms of the purpose of the invention. It appears that no clear oil phase is present at all in relation to Fig. 1, and that only a small clear oil phase is generated at a late stage in relation to Fig. 2.

Fig. 3 is a graph which shows the relative amounts of the various phases after treatment of coconut meat with an enzyme mixture of SPS-ase preparation and GAMANASE®

galactomannase. Thus, Fig. 3 represents the method according to the invention. It appears that a large oil phase is developed after a relatively short treatment time. Thus, the method according to the invention is superior in comparison to the prior art methods.

Fig. 4 is a dose-response curve which shows the effect of an increasing enzyme dosis on the coconut oil yield.

10

DETAILED DESCRIPTION OF THE INVENTION

The invention is further illustrated in the following examples.

15

If the upgraded coconut product produced by means of the method according to the invention is coconut oil, the sludge and the aqueous phase are used as base materials for production of feed or food, and the emulsion is heated to around 90°C in order to liberate the remaining small amount of oil.

20

Example 1 is related to Figs. 1, 2, and 3.

Example 2 is related to Fig. 4.

Example 3 describes a pilot plant experiment according to the invention.

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Example 4, 5, and 6 describe production of coconut milk.

EXAMPLE 1

30

125 g of desiccated coconut meat was mixed with 875 g of water in a reaction vessel. The slurry was homogenized for 2 minutes with an Ultra-Turrax laboratory homogenizer. The pH was adjusted to 4.5 by addition of 6N HCl with stirring.

35

The above procedure was carried out with 3 batches, A, B, and C. Enzymes were then added in the following manner:

Batch A: 5.94 g of SP-249 batch no. PPS 1927 was added, and
5 enzyme hydrolysis took place for 420 minutes at 50°C with continuous stirring.

Batch B: 26.4 g Gamanase was added and enzyme hydrolysis took place for 420 minutes at 50°C with continuous stirring.

10 Batch C: 2.97 g of SP-249 batch no. PPS 1927 and 13.2 g Gamanase was added and enzyme hydrolysis took place for 420 minutes at 50°C with continuous stirring.

For all 3 batches A, B, and C 10 ml samples were
15 taken at times $t = 0, 10, 20, 30, 60, 90, 120, 180, 240, 300, 360$ and 420 minutes. Each sample was boiled for 2 minutes to inactivate enzyme and was subsequently centrifuged in a laboratory centrifuge for 10 minutes at 4000 rpm. The phase
distribution in volume-% (sludge, aqueous phase, emulsion and
20 clear oil) was recorded and is shown in Figs. 1 - 3. It can be seen that the combination of SP-249 and Gamanase gives rise to a large clear coconut oil fraction, whereas use of SP-249 or Gamanase alone gives no or only a small fraction of clear coconut oil.

25

EXAMPLE 2

43.8 g of desiccated coconut meat was mixed with
30 206.2 g of water in a reaction vessel. The slurry was homogenized for 1 minute with an Ultra-Turrax laboratory homogenizer. pH was adjusted to 4.5 by addition of 6N HCl with stirring.

The above procedure was carried out for 7 batches
35 A - G. Enzymes were added in the following manner:

Batch A: No enzymes were added

Batch B: 0.0326 g of SP-249 PPS 1927 + 0.1439 g of Gamanase

Batch C: 0.0652 g of SP-249 PPS 1927 + 0.2877 g of Gamanase

Batch D: 0.1303 g of SP-249 PPS 1927 + 0.5768 g of Gamanase

5 Batch E: 0.2602 g of SP-249 PPS 1927 + 1.1550 g of Gamanase

Batch F: 0.5205 g of SP-249 PPS 1927 + 2.3060 g of Gamanase

Batch G: 1.0410 g of SP-249 PPS 1927 + 4.6170 g of Gamanase

For all batches the hydrolysis was carried out at
10 50°C for 4 hours.

After hydrolysis the slurry was boiled for 5
minutes in order to inactivate the enzymes, and subsequently
the slurry was centrifuged for 10 minutes at 4200 rpm in a
laboratory centrifuge. The supernatant was removed by
15 decantation and analyzed for fat content whereby the oil
yield could be calculated. The results are shown below and in
Fig. 4.

20 Trial	Total enzyme dose (SP-249 + Gamanase) (based on coconut meat)	Oil yield (%)
A	0	42.7
B	0.40	54.4
25 C	0.81	61.4
D	1.62	61.0
E	3.23	81.8
F	6.46	100.0
G	12.9	100.9

30

It is seen that the oil yield increases with
increasing enzyme dose, and that an oil yield close to 100%
can be obtained.

35

EXAMPLE 3

125 kg of desiccated coconut meat was mixed with 875 liters of water in a 1000 liter reaction vessel. The slurry was homogenized by means of an Ultra-Turrax Pilot Plant homogenizer. The pH was adjusted to 4.5 by addition of 6N HCl with stirring. 768 g of SP-249-PPS 1927 and 3412 g of Gamanase were added, and hydrolysis was carried out at 50°C for 4 hours. The slurry was subsequently heated to 90°C for 5 minutes in order to inactivate the enzymes.

Another homogenization was carried out with the Ultra-Turrax Pilot Plant homogenizer before the hot slurry was separated on an Alfa-Laval decanter centrifuge in order to remove solids.

The hot supernatant (90°C) from the solid-liquid separation was separated on a liquid-liquid separating disc-centrifuge (Westfalia SB-7). The oil-containing phase was heated to 90°C and separated once more on the liquid-liquid separating disc-centrifuge. Finally a third separation of the hot oil-containing phase (90°C) was carried out to obtain 74 liters of completely clear coconut oil with 98.8% fat and 1.2% of water corresponding to a yield of 86%. The mass balance of the pilot plant trial is shown in the following table.

MASS BALANCE

	Mass/ amount	Phase distribution				Dry matter		Fat		Protein	
		sludge (%)	liquid (%)	emuls. (%)	oil (%)	amount (kg)	(%)	amount (kg)	(%)	amount (kg)	(%)
Desiccated coconut	125 kg					97.02	121.28	57.4	71.75	6.10	7.6
Water	880 -										
Slurry	1005 -	29	66	5	0						
After homogenizing	1005 -	22	68	10	0						
HCl 33%											
SP-249 enzyme	0.7688 -										
Gamanase enzyme	3.4125 -										
Reaction mixture	1040 -										
Decanter overflow	0.94 t	2	86	12		11.10	104.3	7.3	68.6	0.69	6.5
Sludge from decanter	38 kg					34.08	13	2.2	0.76	3.15	1.2
1. Centrifugation											
Centrifugate	520 kg										
Emulsion	270 l										
Sludge	38 kg					17.87	6.8		1.272	0.48	
2. Centrifugation											
Centrifugate	180 l	0.5	99.5	0	0						
Emulsion	86 l	0	16	10	74						
Sludge	3 kg										
3. Centrifugation											
Centrifugate		0	100	0	0						
Clear oil	74 l	1	1.5	0.5	97			98.8	67		
Sludge	10 kg										

The oil composition was analyzed and compared to a coconut oil manufactured by conventional processing. The results are shown below:

5	Enzymatically extracted coconut oil (%)	Standard coconut oil (%)
10 C-8	7.61	7
C-10	6.36	7
C-12	49.5	45
C-14	18.9	20
C-16	8.68	8
15 C-16:1	0.15	-
C-18	3.07	3
C-18:1	4.90	7
C-18:2	0.84	2
FFA (free fatty acids)	3.5	-

20

It is seen that the composition of the enzymatically extracted coconut oil is closely comparable to a standard quality coconut oil. An FFA-number of 3.5% is not high, when taking into consideration that the oil was

25 manufactured in a batch process, and that the oil was not further purified or refined.

In the previous examples the upgraded coconut product produced by means of the method according to the invention was coconut oil. In the following examples the
30 upgraded coconut product produced by means of the method according to the invention is coconut milk. Coconut milk is a stabilized emulsion of coconut oil in water and soluble components of the coconut meat.

EXAMPLE 4

This example illustrates a method for production of coconut milk on the basis of fresh coconut material on a lab 5 scale.

The shells were removed, and the brown layer was peeled off. The pieces of coconut meat were washed in cold water, cut into smaller pieces and ground on a coffee mill. Then 281 g of ground coconut meat were mixed with 720 g of 10 water and heated to 50°C in a water bath with stirring. The pH-value was adjusted to 4.0 by means of 6 N HCl.

This charge was divided into two equal parts. To part No. 1 was added 1.5 g of Gamanase and 1.5 g of SP-249; no enzyme was added to part No. 2.

15 The hydrolysis was carried out at 50°C and with constant mechanical stirring. 100 ml samples were taken to the times 0, 1, 2, 4, and 6 hours. In order to inactivate the enzymes each sample was boiled for 5 minutes, and then it was centrifuged in a laboratory centrifuge for 20 minutes at 4200 20 rpm. The supernatant was decanted off, weighed and homogenized by means of an Ultra-Turrax laboratory homogenizer. A sample was taken for determination of dry matter. The residual material was lyophilized and subsequently analyzed for the content of fat and protein.

25 The below indicated table shows the yield of dry matter, fat and protein at the times indicated. It appears that after six hours of hydrolysis under the test conditions used in this experiment it is possible to increase the protein and oil yield from 39% and 68% respectively to 55% 30 and 96% respectively.

Sample					
time	enzyme		Dry matter	Protein	Fat
hours	+/-		%	%	%
5					
0	+		45.78	25.32	60.05
1	+		57.90	40.01	77.28
2	+		65.55	46.65	83.44
4	+		68.02	51.51	88.86
10	6	+	72.41	55.03	96.49
	0	-	45.46	25.65	65.34
	1	-	54.04	47.70	72.03
	2	-	51.54	46.21	61.38
15	4	-	55.10	39.44	67.82
	6	-	54.45	38.60	67.83

20 EXAMPLE 5

This example illustrates a method for production of coconut milk on the basis of dried coconut material on a lab scale. Dried coconut meal was ground on a Bauermeister pin 25 mill. Now the ground coconut meal was mixed with water to a coconut meal concentration of 15%, and the mixture was carried through a wet grinding mill (Fryma Zahnkolloidmühle, type MZ). Two 1000 ml hydrolysis samples were taken out (No. 1 and 2), and these were heated to 50°C in a water bath with 30 mechanical stirring, and the pH-value was adjusted to 4.0 by means of 6 N HCl. To the 1000 ml of hydrolysis mixture No. 1 was added 1.5 g of GAMANASE and 1.5 g of SP 249. The hydrolysis was carried out at 50°C and with constant stirring. 100 ml samples were taken out at 35 times = 0, 1, 2, 4, and 6 hours. Each sample was boiled for 5 minutes in order to inactivate the enzymes, and thereafter it

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was centrifuged in a laboratory centrifuge for 20 minutes at 4200 rpm. The supernatant was decanted, weighed and homogenized by means of an Ultra-Turrax homogenizer of the laboratory type. Then a sample was taken out for

5 determination of dry matter. The residual mixture was lyophilized, and then the fat and protein content was determined. Hydrolysis sample No. 2 (1000 ml) was treated as No. 1, except that no enzyme was added.

The below indicated table shows the yield of dry
10 matter, fat and protein at the times indicated. It appears that after 6 hours of hydrolysis under the test conditions indicated in this experiment it is possible to increase the protein and oil yield from 16 and 76% respectively to 64 and 95% respectively.

15

Sample		Dry matter %	Protein %	Fat %
time hours	enzyme +/-			
20				
0	+	53.82	16.93	71.14
1	+	63.68	58.23	82.64
2	+	74.12	61.35	89.79
4	+	78.13	61.61	92.37
25	6	81.99	63.67	94.63
0	-	52.00	16.14	68.73
1	-	54.09	18.95	71.12
2	-	53.43	19.82	74.25
30	4	57.46	19.57	74.77
6	-	57.57	15.64	75.77

EXAMPLE 6

This example illustrates a method for production of coconut milk on the basis of dry coconut material on a pilot 5 plant scale.

78.5 kg of dried coconut meal was ground on a Bauermeister pin mill. Now the coconut meal was mixed with 429.5 kg of water in a 600 l reaction tank and pumped into the hopper of a wet grinding mill (Fryma, Zahnkolloidmühle, 10 type MZ). The ground mixture was pumped back into the tank and heated to 50°C. The pH-value was adjusted to 4.0 by means of 37% HCl with stirring. 762 g of GAMANASE and 762 g of SP 249 was added, and the hydrolysis was carried out for 4 hours at 50°C with constant stirring. Then the mixture was heated 15 to 90°C for five minutes in order to inactivate the enzymes. The sludge was removed from the 50°C hot mixture by means of an Alfa-Laval decanter, and the thus produced coconut milk was concentrated by evaporation on a Niro Atomizer evaporator . to a dry matter content of 65.7% and a protein and fat 20 content of 4.37% and 51.8%, respectively.

The below indicated table shows the yield of dry matter, fat and protein at the times indicated. It appears that after four hours of hydrolysis under the test conditions used in this experiment it is possible to obtain an oil yield 25 of 95% and a protein yield of 80%.

Sample				
time	enzyme	Dry matter	Protein	Fat
30 hours	+/-	%	%	%
0	+	42.11	38.97	72.45
1	+	62.62	57.07	84.97
2	+	49.77	72.02	91.27
35 3	+	57.30	78.59	94.73
4	+	74.08	79.55	95.18

CLAIMS

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1. A method for production of an upgraded coconut product, which comprises the steps of: enzymatically treating an
10 aqueous suspension of particles of coconut meat, which may be purified, with a cell wall degrading enzyme and a galactomannase, all essentially free from lipases, and separating a sludge phase.

15 2. The method according to Claim 1, wherein 90% of the particles of the coconut meat are smaller than 1 mm.

3. The method according to Claim 1, wherein the aqueous suspension of particles of coconut meat is heat treated
20 before the enzymatic treatment.

4. The method according to Claim 1, wherein the enzymatic treatment is carried out with a mixture of an SPS-ase preparation and a galactomannase.

25

5. The method according to Claim 1, wherein the galactomannase part of the enzyme treating agent comprises another hemicellulase besides the galactomannase.

30 6. The method according to Claim 4, wherein between 10 and 700 SPS-ase activity units and between 1.5×10^6 and 200×10^6 galactomannase activity units are used per kg dry matter of coconut meat, and the enzymatic treatment is carried out between 1 and 6 hours.

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7. The method according to Claim 1, wherein the ratio between dry coconut meat and water in the aqueous suspension is between 0.10 and 0.25.

5 8. The method according to Claim 1, wherein the separation of the the sludge phase is carried out by centrifugation.

9. The method according to Claim 1, wherein the separation of the coconut oil is carried out by decantation.

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10. An upgraded coconut product whenever produced by the method of any one of the preceding claims.

11. Any novel feature or combination of features described herein.